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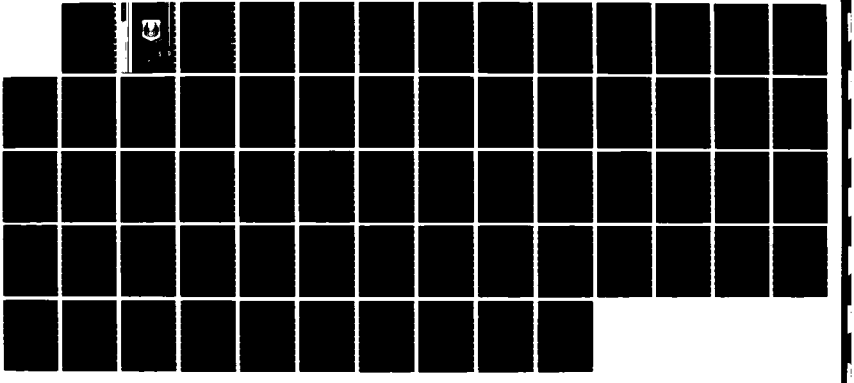

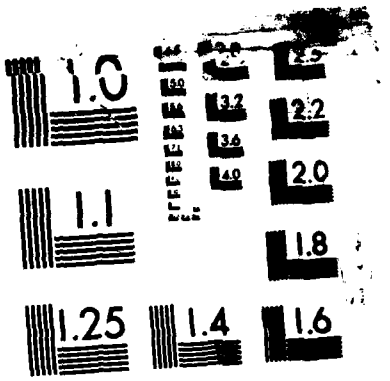

# ANNUAL REPORT

# 1985




## DIRECTORATE OF MANAGEMENT SCIENCES

AFLC/XRS
WPAFB, OHIO 45433

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Summary of significant studies done by AFLC/XRS during the CY1985.

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## FOREWORD

The Directorate of Management Sciences (XRS) conducts and sponsors studies and research of significant logistics issues.

In 1985 we concentrated on assisting the rest of the staff with analyses that relate logistics resource alternatives to the peacetime readiness and wartime sustainability of AFLC's customers--the operating commands. That focus will continue in 1986 and beyond.

In this, our second Annual Report, we will discuss the capabilities of the XRS organization, its goals for the future, some specific accomplishments in 1985, and our program for 1986.

We encourage you to contact us regarding our past, current, and future efforts. If you have a problem, maybe we can help.

VICTOR J. PRESUTTI, JR.
Director, Management Sciences
DCS/Plans and Programs

EDWARD R. BRACKEN
Brigadier General, USAF
DCS/Plans and Programs

## EXECUTIVE SUMMARY

The Directorate of Management Sciences (AFLC/XRS) is comprised of three Divisions: the Assessment Applications Division (XRSA), the Concept Development Division (XRSC), and the Consultant Services Division (XRSM). We conduct and sponsor studies and research of significant logistics issues. We use, modify, and develop new or improved methods, models, and tools to manage logistics resources. We have developed outstanding capabilities in determining requirements for recoverable items (items that are repaired, as opposed to thrown away, when they fail), relating recoverable item assets to the number of aircraft available to accomplish the mission, and relating jet engine maintenance shop resources to aircraft availability.

Our focus is on relating logistics resource alternatives to the peacetime readiness and wartime sustainability of the operating commands. In our scenario, the maintenance, distribution, and procurement systems exist only to provide serviceable Line Replaceable Units (LRUs) to keep end items available. The amount of money we invest in the maintenance system, and how we choose to invest it, affect the Base Repair Cycle Time, Depot Repair Cycle Time, and the fraction of repairs that can be accomplished at base level. The amount of money invested in the distribution system, and how it is invested, affect the time it takes to get a serviceable asset from the repair depot to the base and the time it takes to get a reparable carcass from the base to the repair depot. The amount of money invested in the procurement system, and how it is invested, affect the mean time between demands, how often an item must be thrown away, the unit cost, and the procurement lead time.

We have made a great deal of progress in relating LRU dollars to aircraft availability. We have made some progress in understanding the relationship among maintenance system resources, the number of demands on maintenance, and maintenance times. We have begun work that will help us understand the relationship among distribution system resources, the number of demands on distribution, and distribution times. The Department of Defense is involved in a number of activities that should help us understand the relationship among procurement system resources, the procurement workload, and procurement factors. Once we understand these relationships, we will know the results that can be expected from expenditures in each of the four resource areas. Then we can begin to trade among LRUs, maintenance system resources, distribution system resources, and procurement system resources to obtain the most force readiness and sustainability for our logistics dollars.

Section III of this report contains some specific results obtained in 1985 that are helping us relate logistics resource alternatives to readiness and sustainability. Section IV has a brief description of each of our major projects for 1986.

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# I. THE DIRECTORATE OF MANAGEMENT SCIENCES

The Directorate of Management Sciences (AFLC/XRS) is comprised of three Divisions: the Assessment Applications Division (XRSA), the Concept Development Division (XRSC), and the Consultant Services Division (XRSM). We conduct and sponsor studies and research of significant logistics issues. We use, modify, and develop new or improved methods, models, and tools to manage logistics resources. We keep current on logistics research, developments, and studies both internal and external to the Command. Because of our analytical and technical expertise, we act as technical consultants for other AFLC organizations.

We have twenty military and civilian operations research analysts. Three-fourths of these analysts have advanced academic degrees in technical areas (e.g., management sciences, mathematics, engineering). Each new XRS analyst is expected to have, or obtain within his/her training period (normally three or four years), an advanced degree. Our analysts work with both analytical and Monte Carlo simulation computer models. We have developed outstanding capabilities in determining requirements for recoverable items (items that are repaired, as opposed to thrown away, when they fail), relating recoverable item assets to the number of aircraft available to accomplish the mission, and relating jet engine maintenance shop resources to aircraft availability.

The Directorate works closely, and shares results, with other governmental and private analysis organizations such as the Air Force Institute of Technology, Air University, the AF Office of Scientific Research, the AF Business Research Management Center, the AF Logistics Management Center, the AF Coordinating Office of Logistics Research, the Human Resources Laboratory, the Rand Corporation, and the Logistics Management Institute.

We don't usually work directly with the AFLC Senior Staff. We've found we are most effective when we work very closely with a study sponsor's action officer and let the action officer interact with the Staff.

## II. OUR FOCUS

### A. The Goal

Our goal is to be able to put some numbers on the curve you see in Figure 1. That is, we want to be able to quantify the relationship between logistics resource decisions and operational effectiveness. (Our goal has not changed since last year. Consequently, this section of the report is essentially the same as Section II of our Annual Report for 1984.)

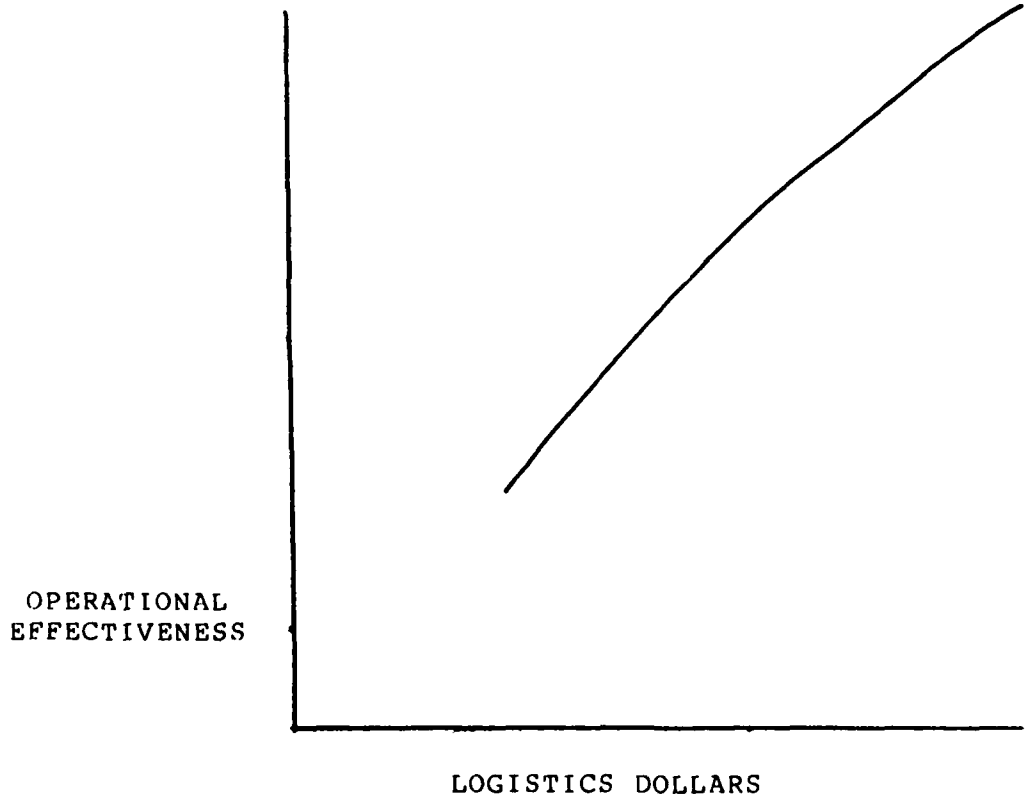



Figure 1

Before describing how we intend to accomplish our goal, we need to say a few words about our view of the logistics world. Our focus is on AFLC's job of making sure we have enough end items "ready"

and "sustainable" to meet the threat. By end items, we mean aircraft, spacecraft, missiles, simulators, and other equipment. To make sure we have enough end items available, we use the following logistics resources: Line Replaceable Units (LRUs), the maintenance system, the distribution system, and the procurement system.

An LRU is an item that can be removed and replaced directly from an end item. A Shop Replaceable Unit (SRU) is an item removed from an LRU, in a maintenance shop, during the repair of that LRU. For example, aircraft engines are LRUs and engine modules are usually SRUs. SRUs, maintenance equipment, maintenance facilities, maintenance labor, and a maintenance management system make up the maintenance system. Notice that we have included SRUs in the maintenance system. This approach is not as strange as it appears. SRUs are needed only to accomplish maintenance on LRUs. This approach is also consistent with the position that there are really only two kinds of maintenance--"on-equipment" (LRUs) and "off-equipment" (SRUs). When we use the term "maintenance," we mean off-equipment maintenance. The distribution system consists of distribution equipment, distribution facilities, distribution labor, and a distribution management system. The procurement system consists of equipment, facilities, personnel, and a management system. We are talking here about systems and not organizations. The maintenance, distribution, and procurement systems cut across organizational lines, with AFLC's Materiel Management organization having a big hand in all of them.

In our scenario the maintenance, distribution, and procurement systems exist only to provide serviceable LRUs when and where needed to keep end items available. The amount of money we invest in the maintenance system, and how we choose to invest it, affect the Base Repair Cycle Time (BRCT), Depot Repair Cycle Time (DRCT), and the fraction of repairs that can be accomplished at base level (R). The amount of money invested in the distribution system, and how it is invested, affect the time it takes to get a serviceable asset from the repair depot to the base (O&ST) and the time it takes to get a reparable carcass from the base to the repair depot (RET). The amount of money invested in the procurement system, and how it is invested, affect the mean time between demands (MTBD), how often an item must be thrown away (W), the unit cost (C), and the procurement lead time (PLT).

The number of spare LRUs needed depends on the resupply time and the demand rate. The user's resupply time is affected by R, BRCT, O&ST, DRCT, W, PLT, and RET. His demand rate is determined by the MTBD. Because there will never be enough money to have all the aircraft available, the cost of the item, C, is an important factor in obtaining the most readiness and sustainability for our money. This relationship between LRU dollars and the maintenance, distribution, and procurement systems dollars is illustrated in Figure 2.

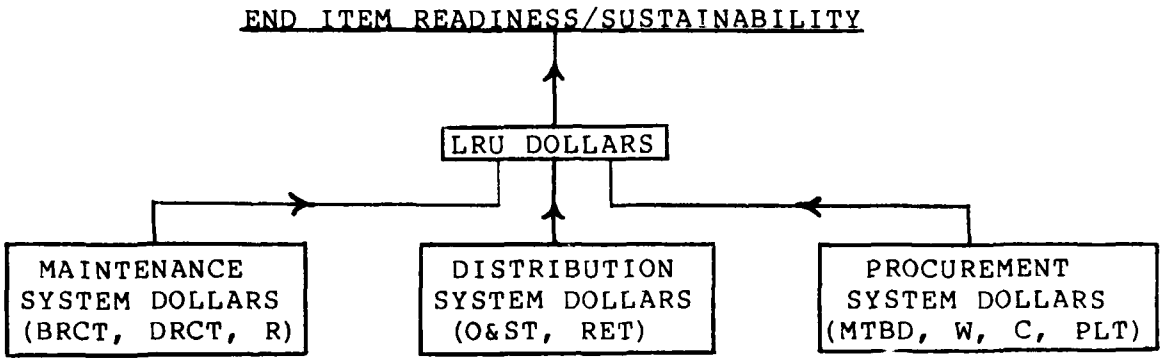



Figure 2

In order to accomplish our goal, we first need to understand and model the interactions within each of the four resource areas. For example, how does money spent on depot maintenance manpower affect the DRCT? Once we know how to model these interactions, we can begin to trade among LRUs, maintenance system resources, distribution system resources, and procurement system resources to obtain the most force readiness (peacetime) and sustainability (wartime) for our logistics dollars.

B. Line Replaceable Units (LRUs).

As mentioned earlier, the first step in accomplishing our goal is an examination of each of the resource areas. We have made by far the most progress in relating LRU dollars to aircraft availability. An Aircraft Availability Procurement Model (AAPM) is about to be implemented in AFLC that allows us to set specific peacetime aircraft availability goals and determine the most economical way, in terms of dollars spent on recoverable items (both LRUs and SRUs), to obtain these goals. This means that we can quantify the relationship in Figure 3 for peacetime operating stock (POS) LRU dollars. AFLC is also in the process of implementing a Weapon System Management Information System (WSMIS) that will enable us to determine the daily availability of aircraft to fly wartime sorties, as a function of recoverable item (again LRUs and SRUs) assets. This means that we can quantify the relationship in Figure 3 for pre-positioned War Reserve Materiel (WRM). Directorate personnel have played important roles in the development and implementation of these capabilities.

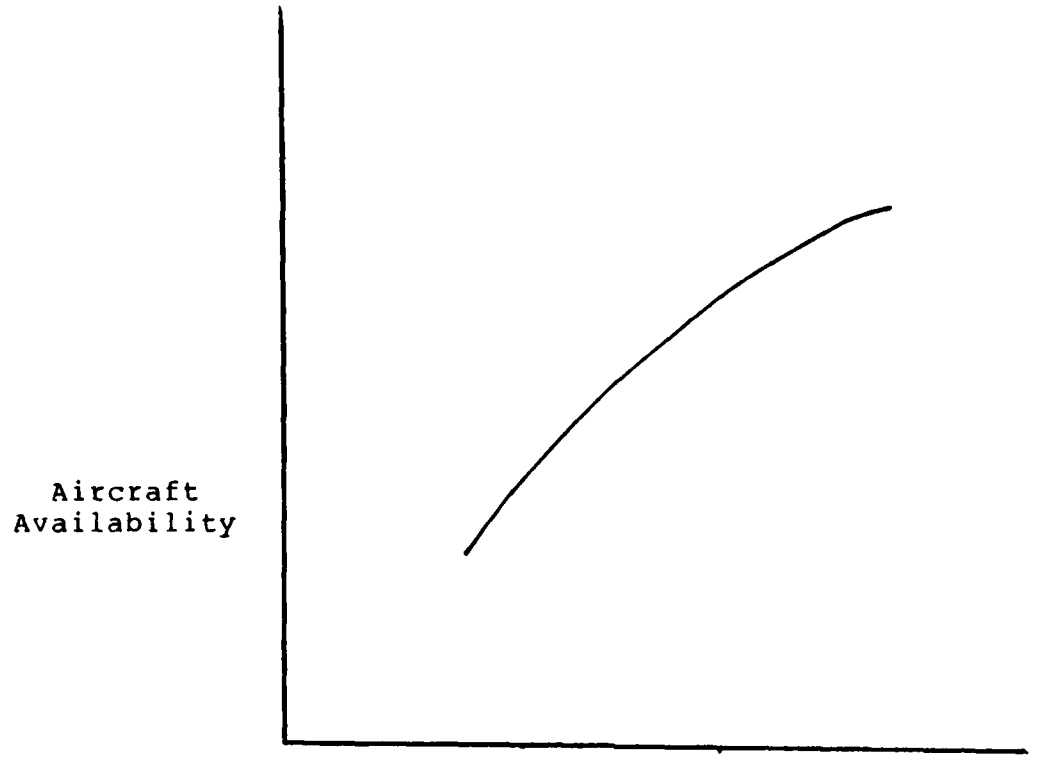



Figure 3

In the next few years, we plan to enhance our ability to relate investments in LRUs to readiness and sustainability in a number of ways.

Right now, aircraft engines are not included in either the AAPM or WSMIS. Consequently, both the AAPM and WSMIS overestimate the connection between a recoverable item that is an engine component and aircraft availability. Because the engine is "transparent," the item is treated as an aircraft LRU and a shortage of that item "downs" the aircraft. In fact, if we have enough spare engines, no aircraft will be down. This problem will be corrected as we help to implement engine information in both the AAPM and WSMIS. Engines will be implemented in WSMIS in 1986.

Support equipment (e.g., a starter unit) is not included in either the AAPM or WSMIS. While this type of equipment is really an end item, it might make sense to treat it as an aircraft LRU, a shortage of which will ground the aircraft. Whether support equipment is treated as an end item, or as an LRU, we will help develop the tools necessary to allow AFLC to incorporate support equipment into both the AAPM and WSMIS.

Munitions are not now included in WSMIS. An interim approach will be included in WSMIS in 1986. More work still needs to be done in this area.

Economic Order Quantity (EOQ), or non-recoverable, items are not now included in the AAPM or WSMIS in spite of the fact that some of them are LRUs. We continue to work with our colleagues in the private sector to find a way to incorporate EOQ items into the AAPM and WSMIS.

There are still some inconsistencies among our initial, replenishment (POS), and wartime requirements computations. For example, War Readiness Spares Kit (WRSK) requirements are computed assuming a full cannibalization policy while the POS requirement assumes there will be no cannibalization. We will analyze the different requirements and assessment approaches and recommend either a single approach or, as a minimum, compatible approaches.

Recently AFLC awarded a multi-million dollar, multi-year contract for the development of the Requirements Data Bank (RDB). The RDB will be the system AFLC uses to determine the material needed in peace and war to support the Air Force's operational commands worldwide. Four XRS analysts are working with our associates in the Materiel Management Deputate to provide the contractors with mathematical techniques for relating engine, recoverable item, EOQ item, test equipment, and support equipment requirements to readiness and sustainability.

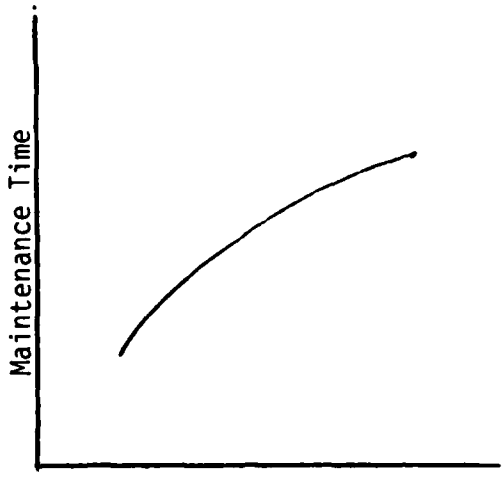
We also have recently become interested in Program Objective Memorandum (POM) forecasting techniques for all recoverables. This is a very difficult area that has, so far at least, refused to yield to micro-modeling approaches such as those used in WSMIS and the AAPM. We believe we understand the problem with micro-models; but, we have not yet discovered any other techniques with which we are particularly comfortable. We will continue our search for a technique that can be used to relate POM forecasts to readiness and sustainability.

C. Maintenance.

As stated earlier, the maintenance system is the system that accomplishes off-equipment maintenance (i.e., we are excluding flight line maintenance). We need to understand the relationship among maintenance system resources, the number of demands on maintenance, and maintenance times (i.e., DRCT and BRCT). That is, for base maintenance shops, and depot maintenance shops (and for consolidated maintenance shops), we need to put some numbers on the curves in Figures 4a and 4b.


Maintenance Investment
(Fixed Maintenance Demands)

Figure 4a




Maintenance Demands
(Fixed Maintenance Investment)

Figure 4b

We have made some progress in this area. In both WSMIS and the AAPM the increase in LRU repair times due to SRU shortages is explicitly taken into account. In the AAPM we actually choose between buying an SRU and buying an LRU based on this relationship. Spare LRUs are either ready to install on an aircraft or in "resupply"--maintenance (including awaiting parts) or distribution. In order to increase the likelihood of having an LRU ready for installation, we can buy more LRUs, or buy more SRUs and reduce the number of LRUs awaiting parts.

We have an XRS developed computer simulation (JEMS) of jet engine intermediate level (base) maintenance shops that can be used to determine the relationship between the resources of the shop (e.g., maintenance personnel, test stands) and maintenance times. This model has been used, by the Military Airlift Command to justify a wartime increase in C-5 engine maintenance crews. In the future we will expand our use of the JEMS model to other aircraft engines.

Many EOQ items are used in the repair of SRUs and LRUs. A shortage of these EOQ items increases the repair times of the SRUs and LRUs (in the same way SRU shortages increase LRU repair times). We are, as stated earlier, working with some of our associates in the private sector to find a way to incorporate EOQ items into the AAPM and WSMIS.

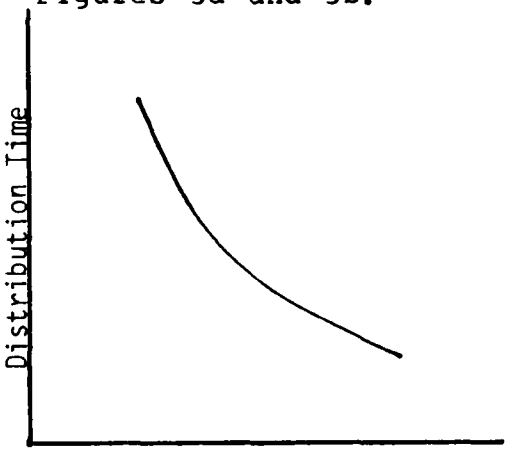
Shortages of test equipment in a maintenance shop also extend item repair times. We plan to enhance WSMIS so that we can quantify the impact of test equipment availability on maintenance times.

We are also heavily involved with the Air Staff and the Rand Corporation on something we call the "Uncertainty Project." While intermediate level (base) maintenance is a key part of this effort,

a particular emphasis is to understand how best to use depot shops to respond quickly to rapid and unpredictable swings in repair requirements such as might occur in the initial stages of a wartime surge.

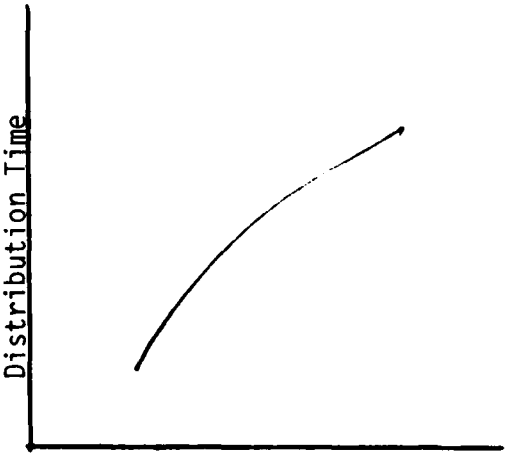
D. Distribution.

We need to understand the relationship among distribution system resources, the number of demands on distribution, and distribution times (e.g., O&ST and RET). That is, for movement of parts among bases and depots we need to put some numbers on the curves in Figures 5a and 5b.




Distribution Investment
(Fixed Distribution Demands)

Figure 5a




Distribution Demands
(Fixed Distribution Investment)

Figure 5b

When we talk about distribution times, we are talking mostly about waiting times. The secret to reducing distribution times is to reduce the time the item spends waiting to be packaged, waiting to be loaded on an aircraft, waiting for whatever.

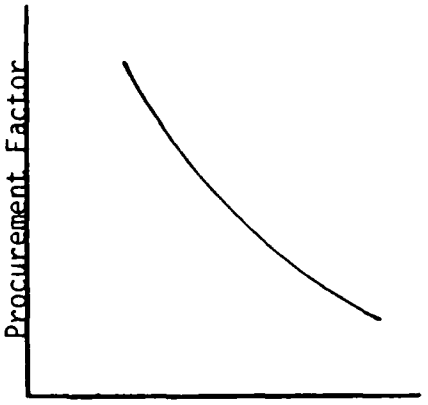
Until recently, we (XRS personnel) have had virtually no contact with distribution issues. In 1985 we helped our co-workers in the Distribution Deputate with a study that will eventually help us establish the relationship among volume of cargo moved within the United States, delivery times, and distribution system costs.

In the joint Rand/AF "Uncertainty Project," we are investigating how to make the distribution system more responsive so maintenance capability within the theater and at the depots can be used to alleviate the swings in repair requirements.

We are also looking at how lateral resupply (the shipment of parts--serviceable or in need of repair--from one user to another user) affects customer resupply times.

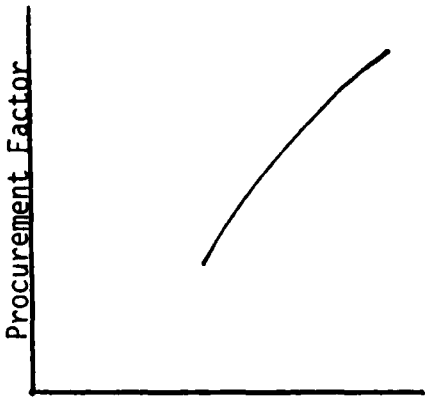
E. Procurement.

We need to understand the relationship among procurement system resources, the procurement workload, and "procurement factors." (See Figures 6a and 6b.) By procurement factors, we specifically mean the demand rate of an item (the reciprocal of the MTBD), how often an item must be thrown away (W), the cost of an item (C), and how long it takes the contractor to deliver an item (PLT).




Procurement Investment
(Fixed Procurement Demands)

Figure 6a




Procurement Demands
(Fixed Procurement Investment)

Figure 6b

This Directorate has no current plans for in-house work in the procurement area. This area is, however, receiving an unprecedented amount of analysis throughout the Department of Defense. Consequently, we expect that in the next few years we will be able to use the results of this analysis to put some numbers on the curves in Figures 6a and 6b.

F. Putting It All Together.

Once we understand the relationships we have described in the previous sections (II.A. through II.E.), we will know the results that can be expected from expenditures in each of the four resource areas. Then we can begin to trade among LRUs, maintenance system resources, distribution system resources, and procurement system resources (see again Figure 2, page 4) to obtain the most force readiness and sustainability for our logistics dollars. That is, we can draw the curve in Figure 1, page 2, with some confidence.

We have begun work on a project we call INTEGRATE. This project will prototype an integrated network of computer models or procedures to produce weapon system capability assessments as functions of the major resources. We plan to have an initial version of it running by the end of 1986. At first, we won't have all the information needed and will need to fill in the blanks with bogus inputs. This will serve two purposes. It will help us understand the mechanism for trade-offs within and among resource areas. It will also provide an incentive to get better data for those areas where we are forced to use "soft" information and results based on this information suggest we should spend less on one logistics area and more on another.

## A. The Assessment Applications Division (XRSA).

**A.1. Introduction.** The Assessment Applications Division (XRSA) focuses on relating the impact of logistics resources to operational effectiveness. Our work is primarily directed toward estimating force effectiveness in wartime surges given currently available recoverable item spares. We work closely with Logistics Management Systems Center (LMSC) developers and Logistics Operations Center (LOC) users of the Weapon System Management Information System (WSMIS) to provide technical direction, resolve a variety of technical implementation issues, and ensure the overall effectiveness and validity of this assessment system. In the future, we will work on expanding the range of logistics resources and the planning horizon that WSMIS encompasses.

We have a staff of five operations research analysts, one logistics staff officer, one computer assistant, and one Junior Fellowship student. The entire Division staff is involved in one or more aspects of weapon system capability assessments as described above. We are the Air Force technical OPR for Dyna-METRIC, the official Air Force model for capability assessments considering recoverable items. We work closely with Dyna-METRIC users, establishing expertise throughout the Air Force and in other agencies and ensuring a continuing ability to use the model in a valid and responsible manner. Our future work in this area will incorporate the additional capabilities of the newest version of the model, expand our ability to consider additional logistics resources, consider more echelons (depot interactions), and include longer time horizons.

Besides our efforts that are directly in support of Air Force weapon system capability assessments, we are working in several development areas. We are the AFLC OPR for the Uncertainty Project, conducted by the Rand Corporation, which we sponsor jointly with the Air Staff. This project has clarified ways our logistics system can be more flexible and responsive to operational needs when environmental fluctuations and item failure rate variations create unanticipated requirements for specific replacement parts at particular locations. A much better understanding of the importance of responsive repair and distribution has been gained. Future work on the project will involve detailed evaluations of algorithms and models developed. Our work will include the resolution of a myriad of implementation issues that must be solved to transform the support system into one that can responsively get the right part to the right place at the right time.

CURTIS E. NEUMANN
Chief, Assessment Applications Division

## A.2. Specific Results.

### A.2.1. TITLE: Support to Development and Implementation of WSMIS

CUSTOMER: LMSC/SMW, LOC/XO

OBJECTIVE: The objective of the project is to provide direction on technical issues of WSMIS development and implementation.

RESULTS: We evaluated functional descriptions prepared by the WSMIS contractors and were instrumental in effecting many improvements to the system. In our role as modeling experts, we provided guidance to the WSMIS program office on numerous issues, including quality control, strategic airlift modeling, munitions assessments, engine modeling, and much more. If we had not provided this support, AFLC would have had no internal understanding of several of these complex issues, and would have not been able to develop the specific solutions necessary for WSMIS to provide credible assessments of weapon system capability.

ANALYSTS: Virginia L. Williamson,
Barbara J. Wieland,
Michael R. Niklas; (513) 257-6920; AV: 787-6920

### A.2.2. TITLE: Uncertainty Project

CUSTOMER: AFLC/XR and USAF/LE

OBJECTIVE: Work with Rand and the Air Staff to determine how best to counter the major environmental and demand rate uncertainties that surround logistics operations and resource allocation decisions. We sponsor this project jointly with AF/LEX/LEY and work very closely with Rand on it.

RESULTS: Responsive repair and distribution were shown to be extremely important in responding to unanticipated item demands. A technique was developed for responsively relating depot repair requirements to operational needs that may also hold promise for making responsive distribution decisions. A survey of characteristics of depot repair shops was made and characteristics of base level repair shops were examined. Rand developed several models of repair processes that will be used to examine prioritization policies within maintenance shops and resource allocation planning. The major AFLC Logistics Management System developments were examined to see how information should be integrated to insure the correct information is in the right place at the right time for making appropriate decisions.

ANALYST: Curtis E. Neumann; (513) 257-6920; AV: 787-6920

**A.2.3. TITLE: Modeling Strategic Airlift in WSMIS**

CUSTOMER: LMSC/SMW, LOC/AT

OBJECTIVE: Solve problems associated with the application of WSMIS to strategic airlift modeling.

RESULTS: Last year we worked with HQ MAC, AFLC LOC/AT, and Dynamics Research Corporation (DRC) to determine the proper way to use Dyna-METRIC to model strategic airlift operations for wartime capability assessments. This year we designed a production system for assessing strategic airlift capability. Several model enhancement and software development needs were identified. These improvements will enable the production system to become a part of WSMIS by December 1986.

ANALYSTS: Capt Thomas L. Brayton,
Michael R. Niklas; (513) 257-6920; AV: 787-6920

**A.2.4. TITLE: Dyna-METRIC 4**

CUSTOMER: LMSC/SMW, LOC

OBJECTIVE: Validate Dyna-METRIC 4, make it available to users Air Force-wide, and provide user support.

RESULTS: This most recent release of Dyna-METRIC (Version 4.4) offers several advantages over the production version (3.04) embedded in WSMIS. It will be particularly useful for predicting wartime aircraft availability and identifying suspected problem parts for (a) units supported by BLSS, (b) cargo aircraft involved in strategic airlift, and (c) engine modeling. We have made Dyna-METRIC 4 available for use on the classified WWMCCS computer as well as AFLC's CREATE computer. We conducted many validation tests and continue to support Air Force users. Additionally, we have greatly simplified the task of running the model.

ANALYSTS: Michael R. Niklas,
Barbara J. Wieland,
Tamara A. Evans; (513) 257-6920; AV: 787-6920

**A.2.5. TITLE: Support to LOC Capability Assessment Modeling**

CUSTOMER: LOC

OBJECTIVE: This is an umbrella project that covers overall capability assessment modeling support to the Logistics Operations Center (LOC). Major assessment issues that we are working on are covered by other projects.

RESULTS: We worked closely with the LOC to find and resolve several problems with current assessment methodology and techniques. We helped LOC personnel develop new rationale and support software for broadening their assessment capabilities. We also helped increase the knowledge and capabilities of LOC analysts in understanding the importance of input data relationships to Dyna-METRIC model assumptions and logic. Some specific accomplishments were: (a) We corrected a problem found by LOC/SC by redesigning the portion of Dyna-METRIC which computes problem parts lists. (b) We worked closely with LOC/PN to determine the deployment allocation of spare engines to war bases. We designed the allocation logic and then developed software which quickly performs the allocations for any single or multiple war plan assessment. LOC/PN is now using it routinely for engine capability assessments. (c) We examined PACAF capability assessments produced by WSMIS and discovered many errors, mostly oversights, but some systemic, of how model parameters were set to reflect the logistics support characteristics of that theater. Because of the serious impact of these and similar errors on the validity of the assessments being produced, we strongly recommended, and helped establish, quality control procedures that will put the LOC Force Structure Directorates in a responsible and accountable position for the validity of WSMIS produced assessments.

ANALYSTS: Michael R. Niklas,
Virginia L. Williamson; (513) 257-6920;
AV: 787-6920

**A.2.6. TITLE: Distribution**

CUSTOMER: AFLC/DS

OBJECTIVE: The initial objective of this project was to gain an understanding of the distribution process in order to determine the factors that affect order and ship times and what actions can be taken that affect the movement of parts.

RESULTS: We participated as analysis consultants on the AFLC/DS CONUS Cargo Movement Requirements study. This not only helped us gain an understanding of distribution, but we provided crucial guidance on structuring the data collection for the study, helped formulate realistic objectives, and strongly influenced the approach for completing the Phase I analysis completed in 1985. In addition to our CONUS Cargo Movement work, we gained a good understanding of the Stock Control and Distribution System, the European Distribution System, and the overseas work load program by participating in discussions between other AFLC offices and Rand Corporation personnel involved in the Uncertainty Project. See the Program for 1986 for further plans.

ANALYSTS: Barbara J. Wieland,
Curtis E. Neumann; (513) 257-6920; AV: 787-6920

**A.2.7. TITLE: Sortie Versus Available Aircraft Performance Measures**

CUSTOMER: LOC/XO

OBJECTIVE: Clarify the difference between the sortie and available aircraft performance measures produced by WSMIS. Examine the sensitivity of each to logistics support changes.

RESULTS: We were early advocates of using available aircraft as opposed to sorties generated as a measure of operational effectiveness in our capability assessment modeling and were instrumental in solidifying the official AFLC position behind available aircraft. Our models are not sortie and mission sensitive, and to suggest they are ignores several operational realities such as the need for multiple aircraft on given missions. To further demonstrate why this is true, we pictorially showed the relationship between these performance measures using a fully funded WRSK, planned sorties, expected Fully Mission Capable (FMC) aircraft, and the minimum FMC aircraft needed to accomplish the required sorties. Then, we showed sorties achieved and available aircraft with a WRSK that was optimally purchased, but only 20 percent funded. While the sortie measure was generally insensitive to this drastically reduced funding, available aircraft dropped dramatically. This clearly showed the merits of the two measures and, as a result, we strongly recommended that WSMIS-produced sortie projections should not be used as stand-alone measures of capability.

ANALYSTS: Curtis E. Neumann,
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**A.2.8. TITLE: Dyna-METRIC Preprocessor Systems**

CUSTOMER: LMSC/SMW, All CREATE Dyna-METRIC Users

OBJECTIVE: Maintain the Dyna-METRIC 3.04 D029 preprocessor on CREATE and review the development of the WSMIS/SAM Dyna-METRIC 4 preprocessor.

RESULTS: The CREATE Dyna-METRIC preprocessor basically reconfigures D029 data into the proper formats for input to the model. D029 is the AFLC data system used to compute War Readiness Spares Kits (WRSK) and Base Level Self-Sufficiency Spares (BLSS) for 30 day logistics support for deployed and in-place units. Because of additional data in D029, we modified portions of the preprocessor and performed many tape conversions so that all users

could benefit from the new fields. We also worked with OO-ALC, tasked with developing a preprocessor for Dyna-METRIC 4, in determining data sources and deciding key issues for the inclusion of the depot portion of pipelines.

ANALYSTS: Barbara J. Wieland,
Capt Thomas L. Brayton; (513) 257-6920;
AV: 787-6920

**A.2.9. TITLE: Effect of WRSK Funding Shortages on Operational Effectiveness**

CUSTOMER: AFLC/XR

OBJECTIVE: To determine the impact on operational effectiveness (in terms of Fully Mission Capable (FMC) aircraft) if War Readiness Spares Kit (WRSK) funding were reduced.

RESULTS: We used the Dyna-METRIC model to compute WRSK funding requirements to achieve various reduced levels of FMC aircraft in generic wartime scenarios. We then used the model to assess these kits to estimate the most optimistic performance we could expect from various levels of reduced funding. We also examined the additional impact of several levels of demand variability. Our analyses confirmed that a reduction in WRSK funding seriously reduces our chances of surviving the early stages of a conflict.

ANALYSTS: XRSA Staff; (513) 257-6920; AV: 787-6920

**A.2.10. TITLE: Munitions Assessment Modeling**

CUSTOMER: LMSC/SMW, LOC/CF

OBJECTIVE: Investigate alternative methods of munitions assessment modeling and determine the best way to incorporate munitions assessments in the WSMIS/Sustainability Assessment Module (SAM).

RESULTS: We evaluated the contractor approach and concurred that munitions should initially be assessed independently of other spares; also approved the selection of TAC's LOGFAC as the munitions assessment model initial operating concept.

ANALYSTS: Virginia L. Williamson,
Michael R. Niklas; (513) 257-6920; AV: 787-6920

**A.2.11. TITLE: Inclusion of Test/Support Equipment in WSMIS/SAM**

CUSTOMER: LMSC/SMW, LOC/CF

OBJECTIVE: The objective of this project is to find the necessary data and determine a means for the WSMIS/SAM to provide assessments of how operational capability is affected by test/support equipment. We expect that support equipment will be incorporated into the SAM differently than test equipment. In fact, a tool other than Dyna-METRIC may have to be added to the SAM in the case of support equipment.

RESULTS: We have become very familiar with the Dyna-METRIC test equipment feature after performing a number of model runs using hypothetical test equipment data. However, we have not completed our evaluation of the suitability of the feature for the needs of WSMIS/SAM nor found the necessary data across all weapon systems needed to drive the model. See the Program for 1986 for the future of this project.

ANALYSTS: Barbara J. Wieland,
Capt Thomas L. Brayton; (513) 257-6920;
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**A.2.12. TITLE: Maintenance**

CUSTOMER: Internal Study

OBJECTIVE: To gain a better understanding of the maintenance process in order to determine the major factors that affect throughput time and what actions could reasonably be taken to affect this time.

RESULTS: Our progress on this project is less than we had hoped for a year ago. We completed a literature search that yielded no promising models or reports, and reviewed the regulation covering the current maintenance workloading and scheduling function. However, we have benefited from our work with the Rand Corporation on the maintenance aspects of the Uncertainty Project and clearly see that flexible and responsive repair is critical to responding to unanticipated operational needs.

ANALYST: Hugh D. Hunsaker; (513) 257-6920; AV: 787-6920

**A.2.13. TITLE: Measure of the Impact of Reliability and Maintainability (R&M) Modifications on Operational Effectiveness**

CUSTOMER: XRS Internal Study

OBJECTIVE: To determine if we can relate R&M funding to aircraft availability.

RESULTS: We found that a model such as Dyna-METRIC might be useful for screening proposed R&M modifications to give gross indications of aircraft availability benefits. However, our findings suggest that more detailed logistics models such as the Logistics Composite Model (LCOM) may be needed to truly isolate the impact.

ANALYSTS: Curtis E. Neumann,
Hugh D. Hunsaker,
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**A.3. Other Division Activities.**

We serve as technical consultant to any AFLC personnel attempting to use the Logistics Composite Model (LCOM). LCOM is a large computer model widely used to simulate the Air Force base level functions of operations, maintenance, and supply.

We helped both Rand and the Requirements Data Bank personnel obtain ten years worth of D041 quarterly data needed for important trend analysis and forecasting work.

We obtained O013 (Packaging and Transportation Data) master files from all of the ALCs and gave copies to Rand, the LOC, and MM for various projects.

We very often obtain data and information for Rand in the areas of supply, transportation, and maintenance.

We are the primary representatives of XRS in matters dealing with our use of mainframe computers. A detailed list of the XRS current and projected computer needs with comments was prepared to help LM better support us. We also provide a great deal of software expertise to the other divisions in XRS, other directorates in XR, and Dynamics Research Corporation, the primary contractor for the WSMIS/SAM.

We are the Air Force experts on Dyna-METRIC (a Rand developed model that predicts wartime weapon system capability based on the recoverable spares asset position). We gave many briefings on this model to interested parties, including representatives of the Singapore defense department and of the West German aircraft firm of MBB.

We helped several AFIT students understand and use the Dyna-METRIC model for thesis work which included studies on the time broken LRU's spend waiting for replacement SRU's and on determining the applicability of Dyna-METRIC for modeling missile systems such as the Minuteman.

We made numerous changes to Dyna-METRIC, later incorporated into the standard model by Rand, which allowed ATC to get very detailed output results when doing engine modeling in the requirements mode.

We assisted AFLC/XRX with a study evaluating the improvement in aircraft availability due to RAF Kemble support. We provided them with modeling expertise, several Dyna-METRIC model output products, and an analysis of the impact of Kemble support to aid in their evaluation.

## B. The Concept Development Division (XRSC).

**B.1. Introduction.** The Concept Development Division performs studies and analyses and provides a source of expertise within the headquarters for several computer models/systems used by AFLC. Our current focus has been on the recoverable item requirements process and the allocation of those requirements between the wholesale and retail levels. In terms of the relationship presented in Figure 2, we have been primarily concerned with determining end item readiness (aircraft availability) as a function of spares dollars (BP1500 expenditures). In fact, we are the AFLC OPR for the Aircraft Availability Procurement Model (AAPM), the model being used to incorporate aircraft availability objectives into the Recoverable Item Requirements System (D041).

Our staff consists of eight Operations Research Analysts and one Computer Assistant. Half of the analysts are currently "on loan" to AFLC/MM where they are working full time in support of the Requirements Data Bank (RDB) project, a large scale effort to improve, modernize and integrate the AFLC logistics requirements management systems. Three of these people will return to XRSC this June and the fourth will return in January 1987. The others are focusing their work on Peacetime Operating Stock (POS) and War Reserve Material (WRM) requirements and allocations. As alluded to in Section II.B., the implementation of the AAPM in the D041 system will mark the attainment of a major milestone in our work.

For the future, we will continue to provide technical assistance for applications and improvements to the AAPM, such as in the area of Other War Reserve Material (OWRM). We will also begin the development of a model which will relate our investment in maintenance capabilities to end item readiness. Eventually we hope to use the expertise gained from the development of this model to investigate ways to optimally allocate funds between our investment in LRUs and our investment in maintenance.

The optimal allocation of logistics resources to maximize combat capability is a complex problem. By focusing our current and future efforts in accordance with the Directorate's long range goal our plan is to develop coherent and consistent concepts which can be effectively implemented.

JOHN M. HILL
Chief, Concept Development Division

**B.2. Specific Results.**

**B.2.1. TITLE: Direct Support to Requirements Data Bank (RDB) Project**

CUSTOMER: AFLC/MMM

OBJECTIVE: To improve, modernize, and integrate the AFLC logistics requirements management systems. In support of this effort, XRS is providing technical direction and guidance in the design and development of the computational techniques to be utilized by the RDB.

RESULTS: The RDB is an on-going effort. During 1985, XRS personnel were actively involved in establishing the conceptual framework for accomplishing the RDB computational objectives. Subsequent efforts are currently underway to further expand and define this framework. The conceptual framework includes all item types (recoverables, consumables, engines, equipment) and all requirement segments (initial, POS, OWRM, WRSK/BLSS). The framework encompasses forecasting techniques, computational modeling and the decision support process.

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Capt Linda Pangborn; (513) 257-5275; AV: 787-5275
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**B.2.2. TITLE: Incorporate Aircraft Availability Requirement Techniques into D041**

CUSTOMER: AFLC/MM

OBJECTIVE: (1) Develop the algorithms required to incorporate aircraft availability requirement techniques into D041, and (2) provide implementation assistance.

RESULTS: We compared the estimated aircraft availability achieved by the VSL computed stock level requirement with the Aircraft Availability Procurement Model (AAPM) computed requirement. The following are two striking illustrations of the improved performance:

| MD | Available Aircraft | | Dollars (million) | |
|---|---|---|---|---|
| | AAPM | VSL | AAPM | VSL |
| F-15 | 550 | 512 | 78.1 | 111 |
| F-16 | 728 | 695 | 231.4 | 306.9 |

Aircraft availability logic was used to compute a BP15 spares requirement in D041 for the first time in the March 1985 computation. Testing for full scale implementation which includes BP15 funds execution is still being conducted. Current plans are to implement in early 1987.

ANALYSTS: Capt Melinda W. Grant,
Bill Wysinski,
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**B.2.3. TITLE: Compute OWRM Recoverable Item Requirements Using Aircraft Availability Techniques**

CUSTOMER: AFLC/MMM

OBJECTIVE: Develop and prototype the capability to compute OWRM recoverable item requirements with aircraft availability techniques.

RESULTS: We are developing required input data to test the proposed techniques. We have succeeded in developing indenture files and are beginning to develop the necessary pipeline data. Work on this project will continue into 1986.

ANALYST: Frederick H. Rexroad; (513) 257-6920;
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**B.2.4. TITLE: D028 Central Leveling System**

CUSTOMER: USAF/LEY

OBJECTIVE: Investigate three aspects of the D028 Central Leveling System which are possible problems.

1. Investigate the impact of the D028 requirement that each base receive a minimum of one unit of stock; this minimum is not currently imposed in the D041 requirements computation.

2. Investigate the percentage of DØ28 items not keeping the depot repair cycle quantity of stock at the depot.

3. Investigate the volatility of the DØ28 stock levels computed each month; determine if DØ28 is reacting to changes in the supply system or if the monthly changes in stock levels are responding to variability inherent in the system.

RESULTS: Initial analyses of items 2. and 3. have been completed and briefed to the Air Force Stockage Advisory Board. Items which fail to keep the depot repair cycle quantity at the depot have been characterized (expensive, long depot repair cycle time, high demand rate items). The volatility of stock levels seems to be attributable to additions/deletions of users and low demand rates. To address the one-per-user rule, we have obtained the DØ28 source code and are in the process of developing an in-house capability to run the model. Work will continue on all problems in 1986.

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**B.2.5. TITLE: Installed Thrust Computing System (TCS)**

CUSTOMER: LOC/PN

OBJECTIVE: Determine the reduction in exhaust gas temperature (EGT) obtainable for the J-85 engine when modified with TCS.

RESULTS: EGT reductions are believed to decrease engine hot-section parts consumption. A linear regression analysis of thrust data indicated that TCS could provide a modest savings in EGT. Implementation of TCS will depend on resultant life cycle cost estimates and engineering analysis of the suitability of installed thrust as a surrogate measure of dynamic thrust.

ANALYSTS: Victor J. Presutti, Jr.,
LTC Michael R. Lacey; (513) 257-3201;
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**B.2.6. TITLE: Aircraft Availability Level of Indenture Study**

CUSTOMER: XRS Internal Study

OBJECTIVE: The current version of the Aircraft Availability Procurement Model accepts five levels of indenture. This study looked at the difference in results between treating all items as Line Replaceable Units (LRU's) or recognizing the hierarchical nature of the items through indenture files.

RESULTS: By analyzing the results from six MDs, we have estimated that modeling indenture relationships reduces reparable item expenditures by about 5 percent at current availability goals. This equates to a savings of approximately $98,000,000.

ANALYSTS: Bill Wysinski,
Major Ron Stokes; (513) 257-6920; AV: 787-6920

**B.2.7. TITLE: Develop WARS Research Model**

CUSTOMER: XRS Internal Study

OBJECTIVE: The Wartime Assessment and Requirements Simulation (WARS) model computes WRSK/BLSS and OWRM requirements to specified availability objectives. The mathematical algorithms (pipeline and optimization) have been programmed and verified by a contractor. The objective of this project is to develop the capability within XRS to run and modify the WARS mathematical algorithms.

RESULTS: We have been able to run the optimization algorithm on AFLC's CREATE computer system with a sample data base. However we do not have the necessary data inputs to compute requirements or make assessments at this time. Continued work on this project will depend on the availability of resources.

ANALYST: Frederick H. Rexroad; (513) 257-6920;
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**B.2.8. TITLE: Aircraft Availability in D028**

CUSTOMER: AFLC/MMM

OBJECTIVE: Determine the feasibility/desirability of changing the basis of the D028 allocation of the D041 computed worldwide requirement from minimizing expected backorders to maximizing aircraft availability.

RESULTS: We were able to show that the present method used in D028 of distributing D041 computed spare parts requirements to minimize worldwide expected backorders does not necessarily produce the best mix of available aircraft. By modifying the algorithm to reflect the relative value of each aircraft type and then distributing requirements such that the value of fully mission capable aircraft is maximized, we can get a better mix of aircraft for the same investment in spare parts. We have obtained the D028 source code and have run the model on AFLC's CREATE system. Using a full

data set from SA-ALC, we observed output differences between the CREATE version and the official San Antonio (CYBER) version. We are in the process of converting the program to our own CYBER computer to analyze these disparities.

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**B.2.9. TITLE: IG Safety Office Project**

CUSTOMER: AFLC/IGYG

OBJECTIVE: Develop automated management tools for early identification of ALC offices with safety problems.

RESULTS: We have developed, using the previous two years' history, control charts for five different categories: body part injured, type of accident, accident cause, accident agency, and injury agency. Current data are used to isolate categories which show significant deviations. Using a statistical package such as SPSS, problems can then be isolated to specific office symbols for each category in each of the ALCs.

ANALYSTS: Capt Melinda W. Grant,
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**B.2.10. TITLE: The Effects of Condemnations in the D028 Central Leveling System**

CUSTOMER: HQ AFLC/MML; HQ ATC

OBJECTIVE: Determine how reparable item condemnations should be modeled in the D028 Central Leveling System.

RESULTS: D028 distributes the worldwide requirement (from D041) for recoverable items among individual bases and the depots. As implemented, D028 modeled a conservative system with no condemnations. We added base and depot condemnations to the algorithm and tested it with data supplied by San Antonio ALC. We concluded that modeling base condemnations significantly improves the model. Our recommendation to incorporate base condemnations has been accepted and the change is now being implemented.

ANALYST: Capt Melinda W. Grant; (513) 257-6920;
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**B.3. Other Division Activities.**

We are the Air Force experts on Mod-METRIC (a requirements computation tool which determines initial recoverable spare part quantities needed to achieve a desired level of base level LRU backorders). We have consulted with ASD and IBM about the use of Mod-METRIC for initial provisioning of the COMBAT TALON II aircraft; we provided information on Mod-METRIC to representatives of the Canadian military and the West German government; and we provided the model to the Swedish aircraft company SAAB Scania for some work it is doing.

We are the Air Force technical experts on the Central Leveling System (DØ28). We have briefed this system to USAF/LEY and the Air Force Stockage Advisory Board.

We are the primary point of contact in XRS for matters dealing with small computers. We have customized existing computers and provided original microcomputer software for use both within XRS and for AFLC users outside XRS. We have provided assistance in matching computer hardware and software for specific jobs.

We are the Air Force technical experts on the modeling techniques utilized by the Recoverable Item Requirements System (DØ41). As such we gave several briefings in 1985 on the mathematical concepts incorporated in the DØ41 system. We also perform studies measuring the impact of changes in selected requirement factors on recoverable item requirements.

**C. The Consultant Services Division (XRSM).**

**C.1. Introduction.** The Consultant Services Division, XRSM, contributes to the long range goal of the Directorate of Management Sciences, XRS. That is, we contribute to AFLC's ability to relate logistics resource decisions to force readiness and sustainability. We have three main functions: conduct studies, develop and use computer models, and provide consulting support to the staff.

In our studies role, we conduct studies and assist other AFLC staff agencies in improving logistics policies and procedures. We also assist other agencies and staff offices in assessing logistics readiness, particularly in relating aircraft engine management decisions to aircraft readiness in both peace and war. For example, we conduct analyses of queuing in JEIM (Jet Engine Intermediate Maintenance) facilities, and develop improved methods of forecasting engine removals and requirements.

In doing the study and study support tasks, we often find it necessary to use computer models to describe relationships and constraints within the logistics processes and to forecast what is likely to happen in the future or under different circumstances.

The Division develops and uses models such as JEMS (Jet Engine Management Simulator), ALERT (Air Logistics Early Requirements Technique), Dyna-METRIC, INTEGRATE, and Vari-METRIC. These models support simulations and analyses in many project areas for various staff elements.

In our consulting role, we assist other staff offices and agencies in using models and mathematical and statistical techniques on a wide variety of topics and short term tasks. Much of this is done informally by phone or in meetings.

We have a staff of seven analysts, two reservists, and a Junior Fellowship student, most of whom have advanced degrees in technical areas such as mathematics or engineering. Each analyst tends to specialize in some major area of logistics management.

John L Madden

JOHN L. MADDEN
Chief, Consultant Services Division

**C.2. Specific Results.**

**C.2.1. TITLE: POM Forecasting**

CUSTOMER: AFLC/MM

OBJECTIVE: To review/develop alternative aggregate methods for forecasting the Program Objective Memorandum (POM) budget requirements by weapon system and in total, and to develop techniques for relating changes in budgets presented in the POM to expected changes in sorties (or other appropriate measures) that can be achieved for a given weapon system.

RESULTS: During CY 85 we conducted an analysis of the POSSEM, ALERT, and NETREM models. The POSSEM and ALERT portions of this project were briefed at Air Staff level. We also studied cost per flying hour, cumulative budget techniques, and the relation of the AFLC budget to the GNP, the Federal budget, and the AF budget to gain insight into possible forecasting methods. To date, a reliable forecasting method has not been obtained. However, work will continue on this project throughout CY 86. The analyses we have conducted throughout CY 85 have shown that the methods currently being used (ALERT and POSSEM) may introduce large errors into the POM forecasting arena.

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**C.2.2. TITLE: Jet Engine Management Simulator (JEMS)**

CUSTOMER: AFLC/MMMA, XRS, LOC/PN, HQ MAC/LGMPE, AFAA/QLW

OBJECTIVE: To develop user friendly Monte Carlo simulation models for each major aircraft weapon system that will relate engine logistics support for both modular and non-modular engines to aircraft capability. To apply these models to specific engine logistics issues. To determine how engine readiness and sustainability are related to initial D-day status variables such as spares, JEIM awaiting parts time, NRTS rates, and depot flow times.

RESULTS: Current TJEMS models exist for the TF-39/C-5, J-79/F-4, and TF-33-P7/C-141. A new TF-39/C-5 model has been developed for use in an AFAA study of JEIM workloading in 1992.

ANALYSTS: John L. Madden,
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**C.2.3. TITLE: Jet Engine Management Simulator (JEMS) Applications**

CUSTOMERS: AFLC/MMMA, AFAA/QLW

OBJECTIVE: To assist users in setting up and conducting simulation studies of given management issues using one of the JEMS models.

RESULTS: Two studies were conducted using JEMS in 1985. The first helped AFLC/MMM determine the impact on C-5 wartime aircraft availability from TF-39 Jet Engine Intermediate Maintenance (JEIM) inwork times during surge and sustained war periods. Assessments were based on inwork times developed jointly by AFLC/MMMA, HQ MAC, and AFSMMET. The study found that aircraft availability was limited by JEIM manhour shortfalls in the sustained period. Results were provided to MMMAE. A second study began in late 1985 and is continuing into 1986. This study is being done for AFAA/QLW to determine whether or not JEIM facilities at Dover AFB and Travis AFB are capable of supporting the entire C-5A/C-5B fleet through 1992 at both peace and war rates. Initial findings suggest that the single test cell at Dover AFB may not be adequate during a long sustained war and might cause bottlenecks in the JEIM facility.

ANALYSTS: John L. Madden,
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**C.2.4. TITLE: Requirements Data Bank (RDB) - Engines**

CUSTOMER: AFLC/MMM

OBJECTIVE: To provide technical support for engine requirements forecasting to the RDB task group member in MMMA. The overall goals are to enhance the forecasting techniques, develop improved factors, and identify the necessary interfaces between engine requirements and the RDB.

RESULTS: Since May 85 XRSM personnel have been helping MMMAE review the existing D042 products relating to the aircraft engine actuarial data collection and forecasting system. Data for five years on six engine types were reviewed. Repair time distributions were developed for unscheduled and scheduled removals by engine type. The average repair times, along with the shapes of the distributions, were significantly different between the scheduled and unscheduled removals on each of the six engine types. Distributions were also developed by command and by base. Significant differences between commands suggest separating scheduled and unscheduled assessment exercises by command. These results were briefed at the Engine Failure Analysis Workshop, chaired by LOC/PN. Data on the OC-ALC managed engines were analyzed to determine whether or not there was a tendency toward sending a higher percentage of engine removals to the depot for repair as the engine ages approached the maximum operating times. This tendency was found in several engines, but not in all. MMMAE was given this information. We are also considering basing actuarial removal rates on the engine time since the last removal instead of on the engine time since the last overhaul as is currently done. The present system may have masked many age-related relationships. This phase will continue into 1986.

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**C.2.5. TITLE: EOQ-METRIC**

CUSTOMER: AFLC/MMMA

OBJECTIVE: To develop indentured data files which would include EOQ items. These files would be used in evaluating test models for determining reorder points and reorder quantities for consumable items so as to maximize aircraft availability and for use in other weapon system requirements and assessment models.

RESULTS: Many data sources were screened in an attempt to develop indentured data files which would include EOQ items. Most of the currently available data systems, such as D062, D220, and D039, do not have clean enough data to develop indentured relationships. We were successful, however, in using the SAFE II data base to obtain indenture relationships which include EOQ items. Preliminary analysis shows that about 80 percent of the EOQ items are DLA managed, and we are in the process of getting information for those

EOQ items from HQ DLA/LOO. Information on AF managed items comes from D062 for EOQ and from D041 for recoverable items. This project will continue into 1986.

ANALYST: Tom Stafford; (513) 257-7408; AV: 787-7408

**C.2.6. TITLE: Integrated Capability Assessment Model (INTEGRATE)**

CUSTOMER: XRS Internal Study

OBJECTIVE: To develop an integrated set of computer models or procedures to compute weapon system capability assessments as functions of the major resources, such as spares, manpower, facilities, equipment, munitions, etc.

RESULTS: In 1985, we developed a full-sized indentured data base for the C-5 aircraft and tested Dyna-METRIC 4.4 using this data base. We had many difficulties in getting satisfactory runs within reasonable computer core and machine time limitations. XRSA is helping us determine work arounds for large data bases. We tested one work around that resulted in the development of a much smaller data base consisting only of problem items. Tests showed that this data base would produce comparable answers to those obtained from the full-sized data base. We also started to review the Vari-METRIC model for possible use in this project. This model runs much faster than Dyna-METRIC. This project will continue into 1986.

Analysts: John L. Madden,
Tom Stafford,
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**C.2.7. TITLE: TSAR/TSARINA**

CUSTOMER: XRS Self Initiated

OBJECTIVE: To convert the coding for the TSAR and TSARINA models for use on the CREATE system so that test problems could be run to evaluate the models' usefulness to AFLC. These models simulate air base operations in a theatre to evaluate how a wide range of air base improvement options could increase the combat capability of air bases during wartime. The Rand Corporation developed the models.

RESULTS: A great deal of effort was expended to get the models up and running on the CREATE system. These models require very large central memories and the CREATE computer simply was not

large enough. When and if a virtual memory option becomes available on CREATE, the models should be tested again. A briefing was prepared, stressing output products, to show potential users the value of the models.

ANALYSTS: Don Casey,
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**C.2.8. TITLE: Retention Factors for Aircraft Engines**

CUSTOMER: AFLC/MMMAE, HQ USAF/LEX

OBJECTIVE: HQ USAF/LE tasked HQ AFLC to document the criteria used to justify active and inactive retention requirements for aircraft engines.

RESULTS: Aircraft engine retention factors were produced for 11 aircraft mission/type categories. Factors were influenced equally by USAF aircraft longevity and the amount of foreign country usage. Statistical data for a 40-year period were summarized and formed the basis for the study. Three XRS Working Papers were produced: a) "A Statistical Compilation of Aircraft Engine Reuse Data," b) "A Statistical Compilation of Aircraft Service Life of Type Data," and c) "A Study of Aircraft Engine Spares Retention." The study disclosed that a small number of retention factors are more appropriate for use than the former single factor. The study concentrated on producing factors for inactive aircraft engines. MMMAE plans to revise AFLC Form 536 and the AFLC Supplement to Air Force Manual 400-1 to incorporate these factors and to explain how they are to be used.

ANALYST: Harold Hixson; (513) 257-7408; AV: 787-7408

**C.2.9. TITLE: Transportation Channel Cargo Traffic Forecasting**

CUSTOMER: AFLC/DSXR, HQ MAC

OBJECTIVE: Evaluate forecasting methods which have the potential to improve forecasting accuracy. Organize a study effort for selecting the forecasting method which produces the most accurate forecasts of logistics cargo shipment generations. With this information HQ MAC will be able to accomplish better flight scheduling.

RESULTS: Preparations were made for accomplishing the forecasting study, including building a computer file of historical data and compiling a list of promising forecasting methods to evaluate. This study will be continued in CY86.

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**C.3. Other Division Activities.**

We are the Air Force experts on the Jet Engine Management Simulator (JEMS) model and assist the ALC's, the MAJCOMs, and others in applying it to various aircraft engine studies.

We assisted the Air Force Audit Agency with two studies related to management of the TF 39 engines in the C-5 aircraft.

For our associates in other organizations we developed, found, and used models and computer software routines to facilitate analyses; provided comments on the applicability of a number of mathematical models; and reviewed technical papers.

One of our senior analysts is an Adjunct Professor at the Air Force Institute of Technology's School of Systems and Logistics (AFIT/LS). We also provide guest speakers every quarter to AFIT/LS courses and are the sponsor for the course, LOG 221, Logistics Managers and Computer Simulation.

A "Summer Faculty Program" Research Associate and a Graduate Assistant from Wright State University worked with us during the summer of 1985.

Two USAF Reserve Officers are assigned to XRSM for training as Individual Mobilization Augmentees.

**D. The Contract Study Program.**

**D.1. Introduction.** The AFLC Logistics Management Sciences Contract Studies Program provides for outside analytical studies of military logistics problems. It gives the Commander and his Staff an objective scientific basis for decisions on action to be taken to improve logistics support to the operating commands. We have two methods for contracting: open competition on a study-by-study basis and the Professional Audit and Evaluation Studies contract which is similar to a Basic Ordering Agreement and competed every three years.

Mary E. Oaks

MARY E. OAKS
Study Program Administrator

## D.2. Specific Results.

### D.2.1. TITLE: Air Logistics Center (ALC) Inventory Procedures

CUSTOMER: AFLC/DS

OBJECTIVE: Review ALC practices relative to managing and accounting for inventories and determine efficient methods to achieve improvements in inventory accuracy.

RESULTS: AFLC's inventory accuracy "get well plan" is now being expanded from a conceptual framework to a detailed and documented course of action.

ANALYST: Contract study, Mary Oaks; (513) 257-4535; AV: 787-4535

### D.2.2. TITLE: Simplify AFLC Small Purchase Procedures

CUSTOMER: AFLC/PM

OBJECTIVE: To obtain recommendations on how to simplify AFLC's Small Purchase Procedures.

RESULTS: Some of the recommendations have resulted in changes to various regulations. The administrative lead time for Request for Purchase award should decrease.

ANALYST: Contract study, Mary Oaks; (513) 257-4535; AV: 787-4535

### D.2.3. TITLE: Consumable Item Stockage Policy to Meet a Weapon System Support Objective

CUSTOMER: AFLC/MMM

OBJECTIVE: The objective of this study is to help us relate our investment in consumables (items that are thrown away, as opposed to repaired, when they fail), or EOQ items, to weapons system readiness and sustainability.

RESULTS: A model was developed that should result in better readiness and sustainability for our investment in EOQ items.

ANALYST: Contract study, Mary Oaks; (513) 257-4535; AV: 787-4535

**D.2.4. TITLE: Aircrew Training Devices (Simulators)**

CUSTOMER: LOC/TG

OBJECTIVE: Traditionally, most Aircrew Training Devices (ATD's) have been supported by organic (Air Force) resources at base level and by a mix of organic and contractor resources at depot. The Air Force plans to transition to contractor support of ATDs. The purpose of this effort is to ensure a smooth transition.

RESULTS: Plans are being implemented for total contract logistics support (CLS) of aircrew training devices. Embedded computational systems will be supported by the training device contractor as part of a single system contract support concept. Concepts provided by the study will be implemented as part of the CLS contract.

ANALYST: Contract study, Mary Oaks; (513) 257-4535; AV: 787-4535

**D.2.5. TITLE: Technique for Actual Availability Measurement**

CUSTOMER: AFLC/XRS

OBJECTIVE: There are a number of approximate requirements optimization models that relate dollars spent to aircraft availability. All of these models have assumptions that are not consistent with reality. The objective of this study is to develop a tool that will enable us to determine the effect of these assumptions.

RESULTS: A tool has been developed that will help us convert theoretical availability to actual availability.

ANALYST: Contract study, Mary Oaks; (513) 257-4535; AV: 787-4535

**D.2.6. TITLE: Development of Software Interface and Interactive Features for ALLOCATE**

CUSTOMER: AFLC/DS, LOC/XOL

OBJECTIVE: ALLOCATE is an optimization model that will be used on a daily basis to allocate cargo to aircraft in AFLC's LOGAIR (Logistics Aircraft) System. The objective of this study is to develop the software needed to interface the user with the ALLOCATE model and provide the interactive features needed for a complete user-friendly computer based allocation system. It will be used on the Z-100 computer.

RESULTS: Software has been developed for a model that allows quicker and better allocation of cargo to aircraft.

ANALYST: Contract study, Mary Oaks; (513) 257-4535; AV: 787-4535

## IV. THE PROGRAM FOR 1986

### A. The Assessment Applications Division (XRSA).

**A.1. Introduction.** Here is our program for 1986. The projects are in priority order.

**A.2. The Projects.**

**A.2.1. TITLE: Support to Development and Implementation of WSMIS**

CUSTOMER: LMSC/SMW, LOC/XO

OBJECTIVE: The objective of this project is to continue taking an active role in providing direction to the Program Office, development contractor, and users on technical issues.

ANTICIPATED BENEFITS: Review technical accuracy of weapon system representation in WSMIS, evaluate accuracy and efficiency of contractor produced software, and analyze system operating procedures. WSMIS relates logistics resources to aircraft availability and readiness, provides capability to analyze logistics limiting factors, and identifies possible corrective actions.

ESTIMATED COMPLETION DATE: This program will continue into 1987.

ANALYSTS: Virginia L. Williamson,
Barbara J. Wieland,
Michael R. Niklas,
Curtis E. Neumann; (513) 257-6920; AV: 787-6920

**A.2.1. TITLE: Uncertainty Project**

CUSTOMER: AFLC/XR/MM and USAF/LE

OBJECTIVE: Work with Rand, various AFLC organizations, MAJCOMs, and the Air Staff to determine how best to counter the major environmental and demand rate uncertainties that surround logistics operations and resource allocation decisions.

ANTICIPATED BENEFITS: In the next year, we expect that the effects of an improved responsive prioritization of repair requirements based on operational needs will be demonstrated. Also, the benefits of prioritization within the maintenance process will be shown. A general officer steering group (MM, XR, MA, LOC/CC, SI, DS) will be established to guide the examination and resolution of several policy and implementation issues resulting from this project. This is a major logistics initiative, Coupling Logistics to Operations to meet Uncertainties and the Threat (CLOUT). We will chair the Working Group. It is expected that the repair

requirements techniques developed through this effort will be incorporated into the Requirements Data Bank (RDB) design and measurable progress will be made in the development of a logistics command, control, and communications system.

ESTIMATED COMPLETION DATE: Complete the evaluation of repair requirements techniques, define the fundamental operation of a logistics command and control system, and thoroughly test repair process models in 1986. Remainder will continue into 1987.

ANALYST: Curtis E. Neumann; (513) 257-6920; AV: 787-6920

**A.2.3. TITLE: Lateral Resupply Modeling for Strategic Airlift Assessments**

CUSTOMER: HQ MAC, LMSC/SMW, LOC/AT

OBJECTIVE: Develop a method for determining the impact of a lateral resupply policy upon aircraft availability.

ANTICIPATED BENEFITS: We are developing a lateral resupply approximation for inclusion in the WSMIS strategic airlift assessments. A capability assessment technique which can accommodate lateral resupply decision rules will improve the accuracy of the WSMIS strategic airlift assessments.

ESTIMATED COMPLETION DATE: December 1986

ANALYST: Michael R. Niklas,
Tamara A. Evans; (513) 257-6920; AV: 787-6920

**A.2.4. TITLE: Dyna-METRIC 4**

CUSTOMER: LMSC/SMW, LOC

OBJECTIVE: Continue with validation of Dyna-METRIC 4. Enhance the model, as needed, for specific Air Force applications. Ensure this version of the model is ready for incorporation into WSMIS by the end of 1986.

ANTICIPATED BENEFITS: Following validation, Dyna-METRIC 4 will become an approved Air Force capability assessment tool and will become an integral part of WSMIS. It will help us predict the impact of changes in logistics support upon the performance of WRSK and BLSS-supported units in both peacetime and wartime. Among its applications are: aircraft engine modeling, test equipment modeling, aircraft availability projections during initial provisioning support periods, and strategic airlift modeling.

ESTIMATED COMPLETION DATE: December 1986

ANALYSTS: Michael R. Niklas,
Tamara A. Evans; (513) 257-6920; AV: 787-6920

**A.2.5. TITLE: Inclusion of Test/Support Equipment in WSMIS/SAM**

CUSTOMER: LMSC/SMW, LOC/CF

OBJECTIVE: The objective of this project is to find the necessary data and determine a means for WSMIS/SAM to provide assessments of how aircraft capability is affected by test/support equipment. We expect that support equipment will be incorporated into the SAM differently than test equipment. In fact, a tool other than Dyna-METRIC may have to be added to SAM in the case of support equipment.

ANTICIPATED BENEFITS: The inclusion of test/support equipment in WSMIS/SAM will allow the LOC/CF and the appropriate item managers to better manage test/support equipment by relating the management of these resources to weapon system combat capability.

ESTIMATED COMPLETION DATE: Complete the evaluation of the suitability of the Dyna-METRIC test equipment feature and determine the availability of test equipment data across all weapon systems by December 1986. Work on support equipment modeling will continue into 1987.

ANALYSTS: Barbara J. Wieland,
Capt Douglas D. Stemp; (513) 257-6920;
AV: 787-6920

**A.2.6. TITLE: Distribution**

CUSTOMER: AFLC/DS

OBJECTIVE: The initial objective of this continuing project is to gain an understanding of the distribution process in order to determine the factors that affect order and ship times and what actions can be taken that affect the movement of parts. We will continue as analysis consultants to the DS CONUS Cargo Movement Requirements study in support of this objective.

ANTICIPATED BENEFITS: The second phase of the DS study entails further analysis of the collected Air Force shipment data, formulation of alternative LOGAIR routings, and the application of cost analysis or modeling techniques to test these alternatives against the current system. The results of this part of the study should either help prove that the current LOGAIR system is effective or provide direction for changing LOGAIR.

ESTIMATED COMPLETION DATE: Arrive at initial results from the second phase of the AFLC/DS CONUS Cargo Movement Requirements study by July 1986. Remainder will continue into 1987.

ANALYSTS: Barbara J. Wieland,
Curtis E. Neumann; (513) 257-6920; AV: 787-6920

**A.2.7. TITLE: Maintenance**

CUSTOMER: AFLC/MA

OBJECTIVE: The objective of this project is to gain an understanding of the maintenance process in order to determine the major factors that affect maintenance throughput time and what actions could reasonably be taken to reduce this time. We will examine two of Rand Corporation's newly developed maintenance models (Dyna-SCORE and CRAM) to judge their usefulness and suitability. Several aspects of this project are closely related to parts of the Uncertainty Project which is examining flexible and responsive repair as a way of supporting unanticipated needs of combat units.

ANTICIPATED BENEFITS: Development of specifications for the kind of maintenance models described above. These models will help us determine the best use of maintenance resources for providing maximum logistics support to combat capability.

ESTIMATED COMPLETION DATE: December 1986

ANALYSTS: Michael R. Niklas,
Barbara J. Wieland; (513) 257-6920; AV: 787-6920

**A.2.8. TITLE: Support to LOC Capability Assessment Modeling**

CUSTOMER: LOC

OBJECTIVE: This is an umbrella project that covers overall capability assessment modeling support to the LOC. Major assessment issues that we are working on are covered by other projects. There is some overlap between this project and "Support to the Development and Implementation of WSMIS/SAM."

ANTICIPATED BENEFITS: During the next year we will continue to provide technical assistance to LOC analysts charged with assessing the impact of current stockage positions on wartime aircraft availability. We expect our services to include

clarification of WSMIS and/or Dyna-METRIC output products, correction/development of software, and research of specific modeling problems to instruct the LOC on how to properly set WSMIS input parameters.

ESTIMATED COMPLETION DATE: Will continue into 1987

ANALYSTS: XRSA Staff; (513) 257-6920; AV: 787-6920

**A.2.9. TITLE: Air Defense (AD) Aircraft Competition Logistics Cost Panel Support**

CUSTOMER: AFALC/OAT

OBJECTIVE: To provide Dyna-METRIC modeling support for the AD competition.

ANTICIPATED BENEFITS: Using Dyna-METRIC in the assessment mode with the contractor supplied War Readiness Spares Kit (WRSK) parts lists and stock levels will enable the AD Logistics Cost Panel to judge whether the WRSK scenario can be adequately supported by each contractor's proposed WRSK. Using Dyna-METRIC in the requirements mode will allow the panel to compare the WRSK costs among the bidding contractors.

ESTIMATED COMPLETION DATE: October 1986

ANALYST: Barbara J. Wieland; (513) 257-6920; AV: 787-6920

**A.2.10. TITLE: WSMIS Quality Control System**

CUSTOMER: LMSC/SMW, LOC

OBJECTIVE: Because of our efforts last year, there is now a formal WSMIS quality control system. We will work with LOC/XO and AFLC/MMM to establish guidelines and procedures which will ensure high quality WSMIS products.

ANTICIPATED BENEFITS: An effective WSMIS quality control system will provide for more responsive error detection, quicker determination of the sources of error, a reduction in manhours spent in confusion, and ultimately, better capability assessment products.

ESTIMATED COMPLETION DATE: December 1986

ANALYSTS: Michael R. Niklas,
Virginia L. Williamson; (513) 257-6920;
AV: 787-6920

**A.2.11. TITLE: Munitions Assessment Modeling**

CUSTOMER: LMSC/SMW, LOC/CF

OBJECTIVE: Investigate methods of integrating munitions assessment products from LOGFAC with WSMIS/SAM capability assessments of aircraft spares and engines.

ANTICIPATED BENEFITS: Inclusion of munitions in the WSMIS/SAM program will help LOC/CF and item managers assess munitions and allow comparison of the relative importance of munitions versus other aircraft spares. This capability enables trade-off decisions that will address critical shortfalls. We do not anticipate that this will be a final solution to the munitions assessment problem and expect to be involved in future work to improve this capability.

ESTIMATED COMPLETION DATE: June 1986

ANALYSTS: Virginia L. Williamson,
Michael R. Niklas; (513) 257-6920; AV: 787-6920

**A.2.12. TITLE: Dyna-METRIC User Group**

CUSTOMER: Air Force

OBJECTIVE: Provide a continuing forum for users to share or exchange information concerning analyses, findings, and problems relating to the Dyna-METRIC model and its applications.

ANTICIPATED BENEFITS: The User Group provides a management structure which guarantees systematic and orderly changes to the standard Air Force Dyna-METRIC model in consonance with Air Force objectives and policies.

ESTIMATED COMPLETION DATE: Continuing

ANALYSTS: XRSA Staff; (513) 257-6920; AV: 787-6920

**A.2.13. TITLE: Verification of the Mini-Dyna-METRIC Model for Use on the Z-100**

CUSTOMER: HQ USAF/LEY

OBJECTIVE: Verify that output from the AFLMC Z-100 Mini-Dyna-METRIC computer is compatible with the Honeywell mainframe Dyna-METRIC 3.04 when common scenarios are used.

ANTICIPATED BENEFITS: The Mini-Dyna-METRIC model on the Z-100 will allow base and MAJCOM Weapon System Managers to conduct timely "what if" analyses and specialized assessments. This verification process will provide the assurance that the model is computationally correct and point out areas where problems may arise (if any are found). It will also free valuable main frame computer time that is currently needed to run the Dyna-METRIC model for bases and MAJCOMs.

ESTIMATED COMPLETION DATE: June 1986

ANALYSTS: Capt Douglas D. Stemp,
Virginia L. Williamson; (513) 257-6920;
AV: 787-6920

**A.2.14. TITLE: TEAM SPIRIT Data Analysis**

CUSTOMER: LOC/CC, LOC/XO

OBJECTIVE: To determine if the Variance-to-Mean Ratio (VTMR) calculated from the TEAM SPIRIT combat exercise is significantly different from the default VTMR used in WSMIS/SAM. We will also compare the actual flying program and its results to the WSMIS/SAM model results to get a feeling for the difference between a WSMIS/SAM forecast and an actual outcome.

ANTICIPATED BENEFITS: The analysis of the TEAM SPIRIT results will provide additional insight into the demand process and how the WSMIS/SAM data base and products might be refined.

ESTIMATED COMPLETION DATE: June 1986

ANALYSTS: Virginia L. Williamson,
Tamara A. Evans; (513) 257-6920; AV: 787-6920

**B. The Concept Development Division (XRSC).**

**B.1. Introduction.** During 1986 we will continue our efforts in support of the Directorate's long range goal. Although three of our analysts will return from the RDB project we will continue to support that effort on an individual project basis. The Aircraft Availability Procurement Model and the Aircraft Availability Maintenance Model will be two areas of major importance as we move closer to putting "numbers on the curve." These, and other projects for 1986, are listed below in what we perceive to be an appropriate priority.

**B.2. The Projects.**

**B.2.1. TITLE: Direct Support to Requirements Data Bank (RDB) Project**

CUSTOMER: AFLC/MMM

OBJECTIVE: The RDB objectives are to improve and modernize the AFLC logistics requirements management systems. In support of this effort, XRS will provide technical direction and guidance in the design and development of the computational techniques to be utilized by the RDB.

ANTICIPATED BENEFITS: Improved allocation of resources; improved budget and POM forecasts; all requirements determined in accordance with approved end item readiness goals.

ESTIMATED COMPLETION DATE: Three of the XRS analysts assigned to this development effort and matrixed to MMM will return in June 1986. One XRS analyst will remain until January 1987. After June 1986 additional XRS support to this development effort will be on an individual project basis.

ANALYSTS: Priscilla Chadwick; (513) 898-6113
Capt Linda Pangborn; (513) 257-5275; AV: 787-5275
Deborah Blalock; (513) 257-5360; AV: 787-5360
John M. Hill; (513) 257-6479; AV: 787-6479

**B.2.2. TITLE: Incorporate Aircraft Availability into D041**

CUSTOMER: AFLC/MMM

OBJECTIVE: In the first phase of this project we wrote the program specifications for incorporating aircraft availability requirement techniques into D041. We are now monitoring the output. We will also perform sensitivity analyses.

ANTICIPATED BENEFITS: This project will provide AFLC with the capability to relate specified aircraft availability goals with recoverable spare part requirements.

ESTIMATED COMPLETION DATE: March 1987

ANALYSTS: Major Ron Stokes,
Capt Melinda W. Grant; (513) 257-6920;
AV: 787-6920

**B.2.3. TITLE: Weapon System Phase In/Out and the Aircraft Availability Procurement Model (AAPM)**

CUSTOMER: AFLC/MM

OBJECTIVE: Develop a technique for handling weapon systems being phased in/out of the inventory or experiencing unusual variations in flying hour programs.

ANTICIPATED BENEFITS: A more realistic and consistent requirements computation for affected weapon systems.

ESTIMATED COMPLETION DATE: September 1986

ANALYSTS: Major Ron Stokes,
Capt Melinda W. Grant; (513) 257-6920;
AV: 787-6920

**B.2.4. TITLE: The Aircraft Availability Maintenance Model (AAMM)**

CUSTOMER: AFLC/MMM

OBJECTIVE: Develop a model to estimate the impact of changes in the repair budget on aircraft availability.

ANTICIPATED BENEFITS: The proposed model will give AFLC/MMM the capability to estimate the impact of exchangeable repair budget restrictions on aircraft availability. It will also provide us a starting point for the development of additional models which can address tradeoffs between maintenance capacity and recoverable item spares levels.

ESTIMATED COMPLETION DATE: Initial version of the model will be completed in October 1986. Refinements to the model may continue into 1987.

ANALYSTS: Major Ron Stokes,
Mark Fryman; (513) 257-6920; AV: 787-6920

**B.2.5. TITLE: Compute OWRM Recoverable Item Requirements Using Aircraft Availability Techniques**

CUSTOMER: AFLC/MMM

OBJECTIVE: Develop and prototype the capability to compute OWRM recoverable item requirements with aircraft availability techniques.

ANTICIPATED BENEFITS: A more accurate assessment of aircraft availability and a better mix of recoverable spare parts resulting in greater aircraft availability for a given investment.

ESTIMATED COMPLETION DATE: December 1986

ANALYST: Frederick H. Rexroad; (513) 257-6920;
AV: 787-6920

**B.2.6. TITLE: Evaluate Alternative Forecasting Procedures**

CUSTOMER: XRS Internal Study

OBJECTIVE: Develop computer programs for evaluating alternative spare part requirement forecasting procedures. We would like to compare the impact on backorders of stock levels based on different estimates of mean demands and variance to mean ratios using historical data. The ultimate criteria for judging alternative procedures will be weapon system availability.

ANTICIPATED BENEFITS: Improved forecasting procedures will yield more accurate computation of recoverable spares and maintenance requirements.

ESTIMATED COMPLETION DATE: July 1986

ANALYST: Major Ron Stokes; (513) 257-6920; AV: 787-6920

**B.2.7. TITLE: Analysis of Problem Part Management**

CUSTOMER: AFLC/XR

OBJECTIVE: Determine if there is a relatively unchanging list of "problem parts," which bases cannot requisition under a MICAP status because "sufficient" quantities exist in base repair, but which are in fact continually grounding aircraft due to a lack of serviceables. If such parts exist, recommend management actions to solve this problem. We will collaborate with AFLMC/LGS on this project.

ANTICIPATED BENEFITS: Improved visibility of problem parts; increased aircraft availability.

ESTIMATED COMPLETION DATE: September 1986

ANALYST: Capt Melinda W. Grant; (513) 257-6531;
AV: 787-6531

**B.2.8. TITLE: D028 Central Leveling System**

CUSTOMER: USAF/LEY

OBJECTIVE: Investigate three aspects of the D028 Central Leveling System which are possible problems.

1. Investigate the impact of the D028 requirement that each base receive a minimum of one unit of stock; this minimum is not currently imposed in the D041 requirement computation.

2. Investigate the percentage of D028 items not keeping the depot repair cycle quantity of stock at the depot: try to characterize the items that exhibit this characteristic and find out what makes them different.

3. Investigate the volatility of the D028 stock levels computed each month; determine if D028 is reacting to changes in the supply system or if the monthly changes in stock levels are responding to variability inherent in the system.

ANTICIPATED BENEFITS: Improved understanding of the D028 computation; identification of problem items; final determination of whether D028 should be run monthly (current) or quarterly (like D041 computation).

ESTIMATED COMPLETION DATE: June 1986

ANALYSTS: Capt Melinda W. Grant,
Frederick H. Rexroad; (513) 257-6531;
AV: 787-6531

**B.2.9. TITLE: Defining the Hierarchical Relationship of Reparable Parts**

CUSTOMER: XRS Internal Study

OBJECTIVE: The Reparable Part Hierarchical relationship is included in the Aircraft Availability algorithm being incorporated in D041. This relationship is input to the algorithm in indenture files. We have reason to believe that the indenture files currently being produced in D041 are not as accurate as they could be. The first objective of this project is to improve the accuracy of those indenture files. Simultaneously, we want to develop the capability to create customized indenture files to support other projects.

ANTICIPATED BENEFITS: Increased accuracy in our recoverable item computation. Increased ability to expand aircraft availability techniques into other areas.

ESTIMATED COMPLETION DATE: December 1986

ANALYST: Frederick H. Rexroad; (513) 257-6920;
AV: 787-6920

**B.2.10. TITLE: Develop WARS Research Model**

CUSTOMER: XRS Internal Study

OBJECTIVE: Develop the capability within XRS to run and modify the WARS mathematical algorithms.

ANTICIPATED BENEFITS: Having an in-house capability to run and modify WARS would (1) enable us to verify the accuracy of future production software, (2) give us the capability to make quick turnaround type studies, and (3) give us the capability to compare Aircraft Availability Procurement/Dyna-METRIC/WARS methodologies.

ESTIMATED COMPLETION DATE: June 1987

ANALYST: Frederick H. Rexroad; (513) 257-6920;
AV: 787-6920

**B.2.11. TITLE: Aircraft Availability in D028**

CUSTOMER: AFLC/MMM

OBJECTIVE: Determine the feasibility/desirability of changing the basis of the D028 allocation of the D041 computed world-wide requirement from minimizing expected backorders to maximizing aircraft availability.

ANTICIPATED BENEFITS: Increased end item readiness through a better distribution of parts between the wholesale and retail levels.

ESTIMATED COMPLETION DATE: December 1986

ANALYSTS: Capt Melinda W. Grant,
Frederick H. Rexroad; (513) 257-6531;
AV: 787-6531

**C. The Consultant Services Division (XRSM).**

**C.1. Introduction.** During 1986 and beyond we expect to continue to support the staff and our other customers with projects and consulting services. We will place particular emphasis on the areas of aircraft engine management and POM forecasting. We will also pursue the Directorate of Management Sciences' (XRS) Long Range Plan to develop a capability to relate resource decisions in the major logistics areas to weapon system readiness and sustainability. A major effort involves the development and use of the INTEGRATE model which is described later in this plan. Through INTEGRATE we hope to understand better how resource decisions in

each major area impact upon overall weapon system readiness and sustainability. It will help us understand interactions. It will help us learn how to balance our resources better when trying to assign budgets to each area. Substudies in each major area will help us understand better the relationships between funding and stock leveling, between funding and maintenance flow times, and between funding and distribution flow times. The following projects are listed in priority order.

## C.2. The Projects.

### C.2.1. TITLE: Jet Engine Management Simulator (JEMS) Applications

CUSTOMERS: AFLC/MMMA, LOC/PN, HQ MAC/LGMPE, AFAA/QLW, ALCs

OBJECTIVE: To use one of the TJEMS or MJEMS models to answer specific questions relating aircraft readiness to engine support.

ANTICIPATED BENEFITS: Allows the user to answer a variety of readiness assessment type questions relating to adequacy of engine support and repair capabilities in both peace and wartime scenarios. Some typical questions might be: How will a reduction in spare engines affect the wartime capability? When in the war will there be the greatest impact on this reduction? Which resources should be increased to compensate for low availability rates? Are JEIM facilities adequate for the projected workloads?

ESTIMATED COMPLETION DATE: June 1986 for study of JEIM facilities at Dover AFB and Travis AFB for AFAA/QLW. Follow-on studies may continue into 1987.

ANALYSTS: John L. Madden,
Phil Persensky; (513) 257-7408; AV: 787-7408

### C.2.2. TITLE: POM Forecasting

CUSTOMER: AFLC/MM

OBJECTIVE: To review/develop alternative aggregate methods for forecasting the Program Objective Memorandum (POM) budget requirements by weapon system and in total, and to develop techniques for relating changes in budgets presented in the POM to expected changes in sorties (or other appropriate measures) that can be achieved for a given weapon system.

ANTICIPATED BENEFITS: Improved ability to forecast POM budget requirements and to relate those requirements to readiness and sustainability.

ESTIMATED COMPLETION DATE: Will continue into 1987

ANALYSTS: John L. Madden,
Don Casey; (513) 257-7408; AV: 787-7408

**C.2.3. TITLE: Requirements Data Bank (RDB) - Engines**

CUSTOMER: AFLC/MMM

OBJECTIVE: To provide technical support for engine requirements forecasting to the RDB task group member from MMMA. Support will consist of reviewing the current techniques that were developed in the late 1950's, with a view toward improving the forecast factor development and application techniques within the RDB engine forecast models. The overall goals are to enhance the forecasting technique, develop improved factors, and identify the necessary interfaces between engine requirements and the RDB.

ANTICIPATED BENEFITS: Improved factors and forecast methods will assure more accurate forecasts of engine repairs at both bases and the depot, which in turn will produce a more accurate determination of the resources needed to keep engines and modules from adversely affecting our peace and war programs.

ESTIMATED COMPLETION DATE: December 1986

ANALYSTS: John L. Madden,
Harold Hixson,
Phil Persensky; (513) 257-7408; AV: 787-7408

**C.2.4. TITLE: EOQ Indenture Files**

CUSTOMER: AFLC/MMMA

OBJECTIVE: To develop indentured data sets that include both recoverable and EOQ items for use in requirements and assessment models.

ANTICIPATED BENEFITS: Will be able to determine whether EOQ items should be included with recoverable items in indentured data files when measuring aircraft availability.

ESTIMATED COMPLETION DATE: December 1986

ANALYST: Tom Stafford; (513) 257-7408; AV: 787-7408

**C.2.5. TITLE: Wholesale Fill Rate Study**

CUSTOMER: AFLC/MML

OBJECTIVE: To investigate current Air Force wholesale fill rates and their value as Air Force support indicators. If they have little value, determine other performance indicators the Air Force or AFLC might use to measure the AFLC depots' effectiveness in supporting Air Force mission requirements.

ANTICIPATED BENEFITS: To learn how well AFLC is accomplishing its wholesale EOQ and investment support functions. We may be able to identify actions necessary to improve wholesale performance.

ESTIMATED COMPLETION DATE: June 1986

ANALYST: Don Casey; (513) 257-7408; AV: 787-7408

**C.2.6. TITLE: Transportation Channel Cargo Traffic Forecasting**

CUSTOMER: AFLC/DSXR, HQ MAC

OBJECTIVE: To evaluate forecasting methods which have the potential to improve forecasting accuracy.

ANTICIPATED BENEFITS: DSXR will have a better forecast to forward to HQ MAC. HQ MAC will be given improved monthly channel forecasts of MAC cargo tonnage. With this improved information HQ MAC will be able to accomplish better flight scheduling.

ESTIMATED COMPLETION DATE: September 1986

ANALYSTS: Harold Hixson,
Major John Evans III,
Kim Williams; (513) 257-7408; AV: 787-7408

**C.2.7. TITLE: Jet Engine Management Simulator (JEMS)**

CUSTOMERS: AFLC/MMA, XRS, LOC/PN, HQ MAC/LGMPE, AFAA/QLW, ALCs

OBJECTIVE: To develop Monte Carlo simulation models for major aircraft weapon systems that will relate both modular and non-modular engine logistics support to aircraft capability. TJEMS models are developed for non-modular engines and MJEMS models are developed for modular engines. We need these models so we gain insight into specific engine logistics issues.

ANTICIPATED BENEFITS: Will provide analysts and engine managers with models that will help them determine if engine support is sufficient to sustain wartime requirements. Will help in identifying and responding to potential bottlenecks due to resource limitations (such as number of repair crews, repair parts

shortages, number of work stands, etc.). Also, will help develop better understanding of the dynamics of engine management and provide a common understanding among HQ AFLC, the ALCs and the MAJCOMs.

ESTIMATED COMPLETION DATE: Will continue in 1987

ANALYSTS: John L. Madden,
Phil Persensky; (513) 257-7408; AV: 787-7408

**C.2.8. TITLE: Integrated Capability Assessment Model (INTEGRATE)**

CUSTOMER: XRS Internal Study

OBJECTIVE: To develop an integrated set of computer models or procedures to compute weapon system capability assessments as functions of the major resources, such as spares, manpower, facilities, equipment, munitions, etc.

ANTICIPATED BENEFITS: Provide models to make capability assessments for given resource mixes, help determine more balanced resource allocations, and provide prototype for possible future full scale development and implementation command-wide.

ESTIMATED COMPLETION DATE: Will continue in 1987

ANALYSTS: John L. Madden,
Tom Stafford,
Phil Persensky; (513) 257-7408; AV: 787-7408

**D. The Contract Study Program.**

**D.1. Introduction.** In 1986 the focus of the contract study program will continue to be operations research/management sciences types of studies relating logistics resource decisions to operational readiness and sustainability.

**D.2. The Projects.**

**D.2.1. TITLE: Assessment Modeling with Limited Repair and Transportation Capabilities**

CUSTOMER: AFLC/XRS

OBJECTIVE: This is a two phase effort. The objective of Phase I is to develop an efficient, accurate approximation technique for calculating wartime surge queue lengths and times caused by capacity constraints of a service facility, such as a

repair center or a transportation segment. Phase II will modify the existing Dyna-METRIC 4.4 model by incorporating the approximation techniques developed for queue lengths and times.

ANTICIPATED BENEFITS: An approximation technique that will consider repair and transportation capacity constraints and thus provide more realistic weapon systems capability assessments.

ESTIMATED COMPLETION DATE: Contract not yet awarded.

ANALYST: Contract study, Mary Oaks; (513) 257-4535; AV: 787-4535

**D.2.2. TITLE: Inventory and Assessment of Air Force Maintenance Training Devices**

CUSTOMER: LOC/TG

OBJECTIVE: Develop for maintenance training devices:

1. an inventory listing

2. a method for tracking Class IV and V modifications

3. a method for tracking disparities between the trainers and the actual equipment

4. logistics support assessment models

ANTICIPATED BENEFITS: More effective support of ATC's technical training mission.

ESTIMATED COMPLETION DATE: Contract not yet awarded.

ANALYST: Contract study, Mary Oaks; (513) 257-4535; AV: 787-4535

**D.2.3. TITLE: Development of a Materiel Requirements Forecasting System**

CUSTOMER: AFLC/MMM

OBJECTIVE: Develop a requirements forecasting system for short, intermediate, and long-range time horizons.

ANTICIPATED BENEFITS: A more credible requirements statement.

ESTIMATED COMPLETION DATE: Contract not yet awarded.

ANALYST: Contract study, Mary Oaks; (513) 257-4535;
AV: 787-4535

**D.2.4. TITLE: Assessing the Effect of Spare Engine and Module Assets on Budget Program 1500 (BP-15) Peacetime Operating Stock Requirements**

CUSTOMER: AFLC/XRS

OBJECTIVE: Develop a prototype version of the Aircraft Availability Model (AAPM) that incorporates the effect of spare aircraft engine and engine modules on BP-15 funding requirements. The prototype will be demonstrated on a sample data base of two selected weapon systems.

ANTICIPATED BENEFITS: More accurate statement of requirements for BP-15 engine components.

ESTIMATED COMPLETION DATE: September 1986

ANALYST: Contract study, Mary Oaks; (513)257-4535;
AV: 787-4535

# V. FINAL REMARKS

In this Report we have tried to describe our capabilities, what we are doing, and why we are doing it.

This is our second Annual Report. We are interested in your suggestions for improving the Report or the study program. Write to AFLC/XRS, WPAFB, Ohio 45433, or call (513) 257-3201, AUTOVON 787-3201.

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